

# Design

## Investigating the effect of paraffin on the viscosity of olive oil

**D 1** Aim: To investigate the effect of the amount of paraffin,  $C_{20}H_{42}$ , added to olive oil, oleic acid  $CH_3(CH_2)_7CH=CH(CH_2)_7COOH$ , on the viscosity of the olive oil.

Hypothesis: I expect olive oil to have a greater viscosity due to its greater molecular size and thickness. I also expect the viscosity of the olive oil to decrease as greater amounts of paraffin are added. This is because the paraffin will disrupt the molecular structure of the oleic acid.

Variables:

**D 1** Dependant variable: viscosity of the solution of olive and paraffin. This will be measured by timing how long the solution takes to pass through a pipette.

Independent variable: the volume of paraffin in the solution of olive oil and paraffin. This volume will be increased.

Controlled variable: The temperature of a liquid affects its viscosity. Increasing temperatures cause a decrease in viscosity. Thus, the olive oil and paraffin will be maintained at room temperature, and their temperatures will be measured before each trial.

Apparatus:

- D 2**
- Stopwatch
  - 10 ml pipette
  - 2 Beakers
  - Paraffin
  - Olive oil
  - Measuring cylinder
  - Thermometer

Method:

1. Suck up olive oil into a 10 ml pipette, making sure the level of olive oil surpasses the 10 ml marking line on the pipette. Place a beaker under the pipette.
2. Remove the rubber bulb of the pipette quickly, simultaneously placing your thumb over the end of the pipette.
3. Release your thumb partially, allowing the level of olive oil to fall only to the 10 ml marking.
4. Release your thumb totally allowing the olive oil to pass through the pipette into the beaker. Start the stop watch as you release your thumb and stop timing when the olive oil reached the bottom of the pipette.

**D 3** 5. Repeat this procedure three times for the olive oil and three times for the paraffin for reproducibility.

6. In another beaker make up a solution of  $10\text{ cm}^3$  olive oil and  $2\text{ cm}^3$  paraffin. Measure the viscosity of this using the procedure outlined above, repeating it 3 times.

7. Add to the solution an additional  $2\text{ cm}^3$  paraffin and again measure the viscosity three times.

Keep repeating this adding an additional  $2\text{cm}^3$  of paraffin each time until there is  $10\text{cm}^3$  of paraffin along with the  $10\text{cm}^3$  of olive oil.

D 3

# Investigation 4 paraffin

<b>Criterion</b>	<b>D</b>	<b>DCP CE</b>
Achievement level awarded	3	
Achievement of aspects	p, p, p	

## Assessment

### Design

#### Defining the problem and selecting variables

Partial

The research question is not clearly stated, as the term amount is imprecise. The concept of percentage composition should have been raised as percentage composition by mass, percentage composition by volume or ideally percentage molar composition. The student does not identify all of the relevant controlled variables such as the volume of olive oil and angle of pipette.

The hypothesis is not a mandatory requirement for design assessment but it is an acceptable strategy that encourages students to think about the underlying theory during the design phase.

#### Controlling variables

Partial

Although the student states that the temperature should be measured the method (and subsequent data recorded) did not do this. The method does not address the angle of the pipette.

#### Developing a method for the collection of data

Partial

Although the student planned to repeat trials and to collect sufficient data for subsequent graphical analysis (and a graph was later plotted), it is a significant omission to test only the range from 100% olive oil to a 50/50 volume mixture. Samples with paraffin as the major or sole component should also have been tested. Also, by obviously recycling the liquid mixture each time, with addition of 2 cm<sup>3</sup> of paraffin, the student is not effectively controlling the composition due to residual liquid mixture left in the pipette (which is significant at high oil compositions). Either separate mixtures of each composition should be made up or the pipette thoroughly flushed with each new composition before the measurements are taken.

Investigation 4: Paraffin